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A comparison of blink rate: Reading from VDT vs. hard copy

Abstract

Today's business world has been revolutionized by the advent of video display terminals (VDTs). While more and more people are now working with VDTs, many are experiencing symptoms and will visit optometrists. One of the common complaints is dry feeling eyes. Studies have shown that the formation and stability of the pre-corneal tear film is dependent on the blinking action of the eyelids and that lack of blinking will result in a defective tear film and subsequently a dry feeling of the eyes. In this study, blink rates were compared to determine if part of the discomfort experienced by VDT users was induced by reduced blink rates, and thus dry feeling eyes.

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A COMPARISON OF BLINK RATE: READING FROM VDT VS. HARD

COPY

BY

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KIM LEE, B.S.

A thesis submitted to the faculty of the
College of Optometry
Pacific University Forest Grove, Oregon
for the degree of
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Tom Dvorak, a fourth year optometry student graduating in the Class of 1988. He is a native from California. He grew up on a ranch in rural Oroville, CA and graduated from Las Plumas High School in 1980. He graduated valedictorian and lettered in football, basketball, and tennis, where he was a 4-time All-League performer. Following high school, he attended U.C. Davis where he majored in animal physiology and a minored in exercise physiology. While at Davis, Tom played lacrosse for 4 years and was named to the All-California team his last two years. He entered optometry school in 1984 and became a member of the Beta Sigma Kappa (BSK) Optometric honor fraternity in his third year at Pacific. He will take state board exams this June and July and his future plans are to enter into an existing practice as an associate or set up practice in Northern California.

Kim Lee, a fourth year Optometry student graduating in the class of 1988, is a native of California. He grew up in San Francisco and graduated from Lowell High School where he lettered in cross country, track and wrestling. Following high school, he attended U. C. Berkeley and graduated from there with a B. A. in Physiology. Kim entered Optometry school in 1984 and became a member of the Beta Sigma Kappa Optometric honors fraternity in his third year at Pacific. He will take state board exams this July and his future plans are to either enter into practice as an associate or as a private practitioner in California.

ABSTRACT

Today's business world has been revolutionized by the advent of video display terminals (VDTs). While more and more people are now working with VDTs, many are experiencing symptoms and will visit optometrists. One of the common complaints is dry feeling eyes. Studies have shown that the formation and stability of the pre-corneal tear film is dependent on the blinking action of the eyelids and that lack of blinking will result in a defective tear film and subsequently a dry feeling of the eyes. In this study, blink rates were compared to determine if part of the discomfort experienced by VDT users was induced by reduced blink rates, and thus dry feeling eyes.

INTRODUCTION

The use of video display terminals (VDTs) has become more and more common in business, industry, and by the general public. It is estimated that over 13 million computer terminals are in use in the U. S. and their numbers are growing every day. However, many studies have indicated that well over 50% of computer users experience symptoms of visual stress on a regular, almost daily basis. Among the most frequent complaints of these individuals are general eye discomfort, eye strain, and dry feeling eyes. A study by the Mt. Sinai School of Medicine found that workers who use VDTs suffer more eye irritation than their colleagues who do not use VDTs. This may be because a VDT involves viewing light emitting documents (the screen) rather than light reflecting ones (hard copy) which would present a more visually demanding task than other types of office work. The study also stressed that the amount of concentrated and continuous near work coupled with environmental factors within the office also play a factor in affecting the comfort and efficiency of a workplace.

Since dry feeling eyes is one of the major complaints of VDT users, one may easily hypothesize that this condition may be attributed to a lack of adequate blinking. Studies have shown that the formation and stability of the pre-corneal tear film is dependent on the blinking action of the eyelids, and that lack of blinking will result in a defective tear film and subsequently a dry feeling of the eyes. Some individuals become so involved in their computer work that they end up staring at the screen and forget to blink, or don't blink completely. Research by Ponder and Kennedy (1927) supports this behavior as they observed a decreased blink rate with a variety of visually demanding situations such as reading, Broadbent (1958) observed that a decrease in blink rate is often associated with heightened demands in visual acuity.

When there is a drop in attentional demands of a task, blinks will occur, as seen by Hall (1945) when it was reported that a flurry of blinks occurred when readers shifted from one page of text to another. Thus blink activity seems to reflect the anticipation of a critical stimulus in situations that demand sustained levels of attention and cognitive processing.

While attention has been shown to decrease blink rates, temperature and humidity may also contribute to dry feeling eyes at VDTs, as VDTs are heat emitting sources. After the installation of VDTs into a work area, offices may become overheated or badly controlled for temperature and humidity, thus causing a feeling of dry eyes.

If the computer user is a contact lens wearer, he or she may experience the problem of build up of dirt and debris on the lens surface and a tendency for the lenses to dry out and become uncomfortable to a greater extent than those not working on VDTs. This condition may be attributed to the fact that electrostatic charges on the VDT screen tend to attract dust particles in the air and can become attached to the contact lenses. Dry air in the office and forgetting to blink may also contribute to problems of keeping the lenses wetted.

In light of the information from the literature, this study will attempt to determine if there is a decreased blink rate when a subject reads from a VDT as opposed to hard copy.

METHODS

Thirty subjects (6 females, 24 males) in this study were chosen at random from the student body at Pacific University College of Optometry (PUCO). They had a mean age of 26 years with an age range of 23 to 33 years. All had normal visual acuity

following spectacle or contact lens correction for myopia, hyperopia and astigmatia. The subjects were also free of ocular pathology as determined by a comprehensive visual examination at the PUCO clinic within the past year.

Assessment of blink rates was achieved by analyzing videotapes of each subject. The subjects were aware of being videotaped as they were told to read for comprehension and that their reading behavior was being studied. Subjects were told to get comfortable and then reading material (VDT or Hard copy) was placed 50 cm. from the corneal apex.

Video taping was carried out while the subjects read optometric material. For condition one (video) the subject read material presented on a Macintosh computer screen. For condition two (hard copy) subjects read a continuation of the same material but in hard copy format of the same point type. Subjects were presented the hard copy or VDT condition in a random order with half of the subjects presented the VDT first, while the other half read the hard copy first.

Ambient lighting in the direct vicinity of the reading task at hand was 500 lux while temperature and humidity were also held constant and external sound was kept to a minimum.

Each videotape was analyzed to determine the following for both reading tasks: The total number of blinks over the five minute period, the number of blinks each minute, and any difference in the number of blinks in the first minute compared to the fifth minute.

RESULTS

The data collected from the thirty subjects was analyzed to determine if the blink rates (BR) were significantly different between hard copy and video display

terminal viewing. Mean BR for video was 8.94 blinks/minute and for hard copy was 11.46 blinks/minute (see table 1). Using a one-tailed t-test the number of total blinks for hard copy vs. the total blinks for video was shown to be significantly greater at the ($p < .05$) level. This indicates the subjects blinked more frequently when viewing hard copy than when viewing a VDT.

An ANOVA analysis was used to determine if blink rate for each minute across the five minute span for hard copy and the five minute span for video were significantly different. For video, there was no significant change in blink rates between each one minute interval. For hard copy, using the ANOVA with Scheffe F-test, there were significant differences between the five minute blink rate and each of the other one minute intervals.

The ANOVA analysis comparing each minute interval from hard copy to its corresponding one minute interval from video showed a significant difference between all minute intervals with the exception of the three minute interval. This suggests that for all but the three minute interval (see table 1 and figure 1) subjects had a decreased blink rate when material was viewed from a VDT as opposed to hard copy.

Clinically, the subjects were asked at the conclusion of the experiment which mode (hard copy or VDT) they preferred to view. Seventy-six percent preferred hard copy while thirteen percent preferred video and eleven percent were undecided.

DISCUSSION

A comparison of the total blinks from hard copy versus the total blinks from video showed a significant difference. Fewer blinks were exhibited during video viewing over the five minute time period. This difference may suggest that when one reads from a VDT, one blinks less. A decrease in blinks may cause the pre-corneal

tear film to evaporate, thus exposing the corneal epithelium resulting in the dry eye symptoms of the VDT user.

While the number of blinks for hard copy were greater, the blink rate per minute for both remained nearly constant with the exception of hard copy's fifth minute interval. It showed a significant increase. This may suggest that by the fifth minute of viewing there is a need to blink more frequently but not evidenced in the video mode. In our study the testing period was only five minutes in duration. Future studies are indicated to investigate what effects occur after 10 or 20 minutes of reading both video and hard copy. If, after only five minutes of reading symptoms are produced, it seems logical that the effects should be more pronounced after 10 or 20 minutes. It would be of interest to see whether blink rate increases in the video mode at some time greater than five minutes as did the hard copy, or whether blink rate remains the same.

Subjects were asked which mode, hard copy or VDT viewing they preferred to read. Many of them reported the character contrast of the VDT was annoying and actually made it harder to read while others complained that it was the computer screen flicker which made it harder to read. These subjective complaints exacerbate the symptoms of the VDT user.

CONCLUSION

This experiment was designed to investigate whether decreased blink rates contribute to the feeling of dry eyes when people read from video display terminals. In our study, the subjects did exhibit significantly lower blink rate reading from the video as opposed to hard copy; and, subjectively, 76% preferred reading from the hard copy while only 13% preferred the VDT. Further studies need to be performed to confirm the relationship between the "dry eye" feeling when using VDT's and a decreased blink

rate. These studies should actually access the tear rate as well as the tear break up time.

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VIDEO BLINK RATE DATA

	<u>MEAN</u>	<u>STD. DEV</u>	<u>STD. ERROR</u>
MINUTE 1	8.53	5.46	1.00
MINUTE 2	8.80	5.84	1.07
MINUTE 3	9.43	5.64	1.03
MINUTE 4	9.10	5.63	1.03
MINUTE 5	8.83	4.94	0.90

HARD COPY BLINK RATE DATA

	<u>MEAN</u>	<u>STD. DEV</u>	<u>STD. ERROR</u>
MINUTE 1	10.80	5.92	1.08
MINUTE 2	10.87	5.64	1.03
MINUTE 3	11.17	5.38	0.98
MINUTE 4	11.40	5.82	1.06
MINUTE 5	13.07	5.40	0.99

MEAN BLINK RATES

